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# Proposed Best Demonstrated Available Technology (BDAT) Background Document for F006 (Addendum). Volume 12

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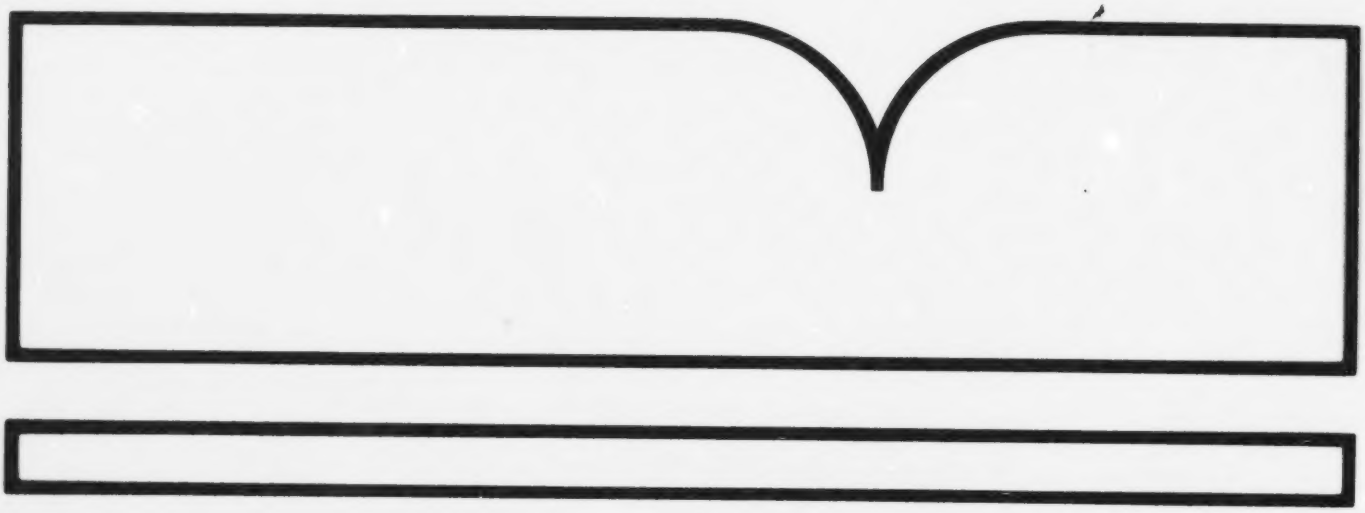

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# PROPOSED BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR F006 (ADDENDUM)

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November 1989

Note: This background document is an amendment to the August 1988 Final Best Demonstrated Available Technology (BDAT) Background Document for F006

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# 1. EXECUTIVE SUMMARY

This document provides the Agency's rationale and technical support for selecting the constituents to be regulated in F006 wastewaters and for developing proposed treatment standards for those regulated constituents. This document is an addendum to the supporting best demonstrated available technology (BDAT) background documents for F006 nonwastewaters. Treatment standards for metal constituents in F006 nonwastewaters were presented in the F006 background document dated August 1988 (USEPA 1988a); treatment standards for cyanides in F006 nonwastewaters were presented in a background document for cyanide wastes dated June 1989 (USEPA 1989a). Information regarding untreated F006 waste and F006 nonwastewater standards can be accessed through these background documents. This addendum contains only information pertaining to the development of treatment standards for F006 wastewaters.

Treatment standards for certain metals contained in F006 nonwastewaters were originally promulgated as part of the First Third rulemaking (53 FR 31152, August 17, 1988). In that rulemaking, the Agency established treatment standards for cadmium, chromium, lead, nickel, and silver, which were found to leach at treatable levels from untreated waste. The treatment standards were based on performance data from stabilization. In the First Third rulemaking, the Agency reserved the nonwastewater cyanide treatment standards for F006 waste.

Treatment standards for amenable and total cyanide in F006 nonwastewaters were promulgated by the Agency as part of the Second Third rulemaking (54 FR 26600, June 23, 1989). The cyanide treatment standards for F006 nonwastewaters were based on performance data from alkaline chlorination followed by chemical precipitation, filtration, and sludge dewatering.

According to 40 CFR 261.32, waste code F006 is listed as "wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum." F006 waste as typically generated is by BDAT definition a nonwastewater. For the purpose of determining the applicability of treatment standards, wastewaters are defined as wastes containing less than 1 percent (weight basis) total suspended solids* and less than 1 percent (weight basis) total organic carbon (TOC). Wastes not meeting this definition must comply with the treatment standards for nonwastewaters. F006 wastewaters are expected to be generated primarily from the following sources: (1) filtrate and/or clarifier overflow from treated electroplating wastewaters, (2) RCRA corrective actions at RCRA facilities, (3) spills.

For F006 wastewaters, the Agency is proposing to regulate cadmium, total chromium, lead, nickel, and total and amenable cyanides. The proposed treatment standards for cadmium, total chromium, lead, and nickel are based on treatability data from the performance of hexavalent chromium reduction followed by chemical precipitation using lime and sulfide and sludge dewatering. The Agency is proposing to transfer metals treatment standards from K062 wastewaters. The proposed treatment standards for total and amenable cyanides are based on the performance of

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*The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, the quantity of total suspended solids is measured by Method 209C (Total Suspended Solids Dried at 103°C to 105°C) in Standard Methods for the Examination of Water and Wastewater, 16th Edition (APHA, AWWA, and WPCF 1985).

alkaline chlorination. The Agency is proposing to transfer cyanide treatment standards from F007, F008, and F009 wastewaters.

Table 1-1 summarizes the proposed treatment standards for F006 wastewaters and the existing standards for F006 nonwastewaters.

Table 1-1 BDAT Treatment Standards for F006 Wastes

| Constituent | Maximum for any single grab sample | | |
|---|---|---|---|
| | Wastewater | Nonwastewater | |
| | Total composition (mg/l) | Total composition (mg/kg) | TCLP (mg/l) |
| Cadmium | 1.6 | NA | 0.066 |
| Chromium (total) | 0.32 | NA | 5.2 |
| Lead | 0.040 | NA | 0.51 |
| Nickel | 0.44 | NA | 0.32 |
| Cyanide (amenable) | 0.10 | 30 | NA |
| Cyanide (total) | 1.9 | 590 | NA |

NA - Not applicable.

# 2. INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

## 2.1 Industry Affected

F006 wastewaters are expected to result primarily from waste treatment operations in the electroplating or metal finishing industries. Using the 1985 Biennial Report Data Base, EPA identified approximately 4,500 facilities as generators of F006 wastes. The process description for generating F006 wastes is outlined in the F006 background document (USEPA 1988a). Since it has not been altered, it is not repeated in this document.

## 2.2 Waste Characterization

Waste characterization data available to the Agency that are applicable to F006 wastes include data for a metal-bearing F006, K062, D002, and D003 wastewater. The data include information for the toxic metals arsenic, cadmium, chromium, copper, lead, nickel, and zinc. These data are presented with the performance data in Section 4 of this document.

Other waste characterization data applicable to F006 wastewaters were collected by EPA's Office of Water for the Effluent Limitations Guidelines for the Metal Finishing Industry (USEPA 1983). These data are presented in Attachment A of this addendum. The waste characterization data in Attachment A include metal finishing industry data for the toxic metals cadmium, chromium, lead, and nickel (Tables 5-18 and 5-19), as well as data for silver (Table 5-20). Additional EPA Office of Water data applicable to F006 wastewaters is presented in the Best Demonstrated Available Technology (BDAT) Background Document for Wastewaters Containing BDAT List Constituents (USEPA 1989d).

# 3. APPLICABLE/DEMONSTRATED TREATMENT TECHNOLOGIES

This section describes the applicable and demonstrated treatment technologies for F006 wastewaters. The technologies that are considered applicable to the treatment of F006 wastewaters are those that treat the proposed regulated constituents by reducing their concentration in the wastewater. This section includes discussions of those applicable treatment technologies and those that have been demonstrated (i.e., are used on a full-scale basis).

## 3.1 Applicable Treatment Technologies

Available information shows that several technologies are applicable for treatment of F006 wastewaters. The leading applicable technology for the removal of metals from plating wastewaters and F006 wastewaters includes (1) a chromium reduction step to treat hexavalent chromium, (2) a chemical precipitation step to precipitate metals out of solution, and (3) a sludge dewatering step to remove the precipitated residues from solution. A potential alternative as BDAT for metals removal is ion exchange. Ion exchange is a treatment technology applicable to metals in wastewaters where the metals are present as soluble ionic species (e.g., $Cr^{+3}$ and $CrO_4^{-2}$). The Agency has identified these treatment technologies because they are designed to reduce the concentration of metals in wastewaters.

EPA has identified four technologies as potentially applicable for treatment of cyanides in F006 wastewaters. These technologies are: (1) electrolytic oxidation; (2) chemical oxidation with several oxidizing agents, such as hypochlorite or chlorine (alkaline chlorination), permanganate, ozone, or $SO_2$/air (Inco process); (3) wet air oxidation; and (4) high-temperature cyanide hydrolysis.

Electrolytic oxidation followed by alkaline chlorination, chemical oxidation (alkaline chlorination or other methods) alone, electrolytic oxidation alone, wet air oxidation, and high-temperature hydrolysis reduce the concentration of cyanide in wastewaters treated. These technologies fully destroy the amenable cyanide present in the waste but treat the complexed cyanides to varying degrees, depending on, among other things, the stability of the metal-cyanide complex and the severity of the oxidizing agent and reaction conditions. Iron cyanide complexes are typically the most resistant to oxidation treatment.

Additional information on the technologies identified to be applicable for F006 wastewaters can be found in the Treatment Technology Background Document (USEPA 1989c).

## 3.2 Demonstrated Treatment Technologies

The treatment technologies identified as being applicable for removal of metals in F006 wastewaters are also considered to be demonstrated because they are used on a full-scale commercial basis for treatment of metal-bearing wastewaters. Hexavalent chromium reduction, metals precipitation, and sludge dewatering are widely practiced metals treatment technologies. Information regarding treatment of precipitated solids (F006 nonwastewaters) is presented in the F006 background document (USEPA 1988a). Ion exchange has also been commercially demonstrated for metals in wastewaters similar to F006 wastewaters. However, concentrating the BDAT list metals on the ion exchange resin substrate creates another hazardous nonwastewater requiring treatment to remove the absorbed metals. This treatment also produces another wastewater requiring either chemical precipitation or recovery of metals.

The treatment technologies identified as being applicable for treatment of cyanides in F006 wastewaters are also considered to be demonstrated. Available information shows that electrolytic oxidation

followed by alkaline chlorination, alkaline chlorination alone, wet air oxidation, high-temperature hydrolysis, and $SO_2$/air oxidation are demonstrated for treatment of cyanide in wastewaters. The Agency has identified at least one full-scale facility that uses electrolytic oxidation followed by alkaline chlorination to treat cyanides, at least five facilities that use alkaline chlorination to treat cyanide wastes (and believes that there are at least hundreds), at least one facility that treats cyanide-containing wastes by high-temperature cyanide hydrolysis, and one pilot-scale facility that has treated cyanide waste by wet air oxidation. In addition, wet air oxidation and $SO_2$/air oxidation are used to treat similar wastes in full-scale processes. Information regarding cyanide treatment of F006 nonwastewaters is presented in the background document for cyanide wastes (USEPA 1989a).

# 4. PERFORMANCE DATA BASE

This section discusses the available performance data associated with the demonstrated technologies for F006 wastewaters. The performance data include the constituent concentrations in untreated and treated waste samples and data on waste characteristics that affect performance. Data used to develop treatment standards are incorporated in the body of this addendum. Data that were considered but not used to develop treatment standards are presented as attachments.

## 4.1 BDAT List Metals Treatment Data

The performance data available to the Agency on treatment of BDAT list metals include 11 data sets from treatment of BDAT list metals in a metal-bearing wastewater by hexavalent chromium reduction followed by chemical precipitation and sludge dewatering. The metal-bearing wastewater included waste codes F006, K062, D002, and D003. These data were previously used in the development of treatment standards promulgated for K062 in the Final Rule for First Third Wastes (53 FR 31164, August 17, 1988). These performance data are presented in Tables 4-1 through 4-11 at the end of this section. They reflect total waste concentrations for BDAT list metals in the untreated and treated wastewater. The Agency believes that K062 wastewaters are more difficult to treat than F006 wastewaters because of the high acidity of K062 and the higher overall concentrations of dissolved metals. Individual metal concentrations in K062 range up to 7,000 ppm. Therefore, the same level of performance achievable for K062 wastewaters is expected to be achievable for F006 wastewaters. When these data were previously used to set treatment standards, it was established that the data are from a well-designed and well-operated system and meet the BDAT Program QA/QC requirements. Specific information on these data is included in Section 4 of the K062 background document (USEPA 1988b).

Performance data collected by EPA's Office of Water for the Effluent Limitations Guidelines for the Metal Finishing Industry (USEPA 1983) is presented in Attachment B. These data contain treated effluent data for wastewaters containing cadmium, chromium, lead, and nickel based on two methods of treatment. One treatment (Option 1) involves hexavalent chromium reduction and cyanide destruction, followed by pH adjustment with lime or caustic to precipitate these metals, settling to remove the metal hydroxides, and discharge of the treated wastewaters. The other treatment (Option 2) involves an additional filtration step to act as a polishing step for the effluent prior to discharge. (The metal finishing industry usually includes a filtration step prior to discharge of the treated effluent.) It should be noted that silver-bearing wastewaters were subjected to various technologies for recovery of silver metal (including evaporation, ion exchange, and electrolytic recovery), unlike the other BDAT list constituents.

The Agency has also evaluated performance data that were developed by EPA's Office of Water for hydroxide precipitation, sedimentation, and filtration for wastes from the metal finishing industry. Further information on these data, including the sources of the data and the treatment technologies used, can be found in Sections III.A.2(a)(3) and III.A.1.H(2) of the Preamble to the Proposed Rule and in the Best Demonstrated Available Technology (BDAT) Background Document for Wastewaters Containing BDAT List Constituents (USEPA 1989d).

The Agency believes that the performance data for the metal-bearing F006, K062, D002, and D003 wastewater are better data for the development of F006 wastewater metals treatment standards than the data collected by EPA's Office of Water for the Effluent Limitation Guidelines (USEPA 1983) and the background document for wastewaters containing BDAT list constituents (USEPA 1989d). The Agency did not use these data because the waste characterization data indicated that the concentration of metals in the untreated wastewater was low compared to those in F006

wastewaters. Individual metal concentrations in F006 wastewaters ranged up to 400 ppm and overall were typically orders of magnitude higher than the concentrations in the wastewaters from EPA's Office of Water data. Additionally, the Agency believes that the data on the F006, K062, D002, and D003 wastewater are better because they have already been used to develop metals treatment standards (for K062 wastewaters) and because metal-bearing K062 wastewaters contain higher concentrations of dissolved metals and, therefore, represents a more difficult waste to treat.

## 4.2 Cyanide Treatment Data

Applicable and demonstrated treatment technologies for cyanides contained in F006 wastewaters were discussed in Section 3. The Agency has no data demonstrating the performance of cyanide treatment specifically for F006 wastewaters. However, performance data available to the Agency on treatment of cyanides in wastewaters were previously used to develop BDAT treatment standards for F007, F008, and F009 wastewaters. The Agency believes that these wastewaters are similar because they both originate from plating activities and are likely to have the same metals and because both may have cyanides. Based on the waste characteristics that affect performance of the demonstrated treatment technologies, such as cyanide concentration, the Agency believes that F007, F008, and F009 wastewaters are more difficult to treat the cyanides than F006 wastewaters because F006 wastewaters contain lower or similar concentrations of amenable and total cyanides. Therefore, the Agency is utilizing the performance data used for F007, F008, and F009 wastewaters to develop cyanide treatment standards for F006 wastewaters. Specific information on these data is included in Section 4 of the background document for cyanides (USEPA 1989a).

Table 4-1 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #1

| Constituent | Untreated K062 waste (mg/l) Sample no. 801 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated waste composite[a] (mg/l) Sample no. 805 | Treated waste (wastewater) (mg/l) Sample no. 806 |
|---|---|---|---|---|
| Arsenic | 3 | <1 | <1 | <0.1 |
| Cadmium | <5 | <5 | 13 | <0.5 |
| Chromium (hexavalent) | I | I | 893 | 0.011 |
| Chromium (total) | 1800 | 7000 | 2581 | 0.12 |
| Copper | 865 | 306 | 138 | 0.21 |
| Lead | <10 | <10 | 64 | <0.01 |
| Nickel | 3200 | 2600 | 471 | 0.33 |
| Zinc | <2 | <2 | 116 | 0.125 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 9 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-2 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #2

| Constituent | Untreated K062 waste (mg/l) Sample no. 801 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated waste composite[a] (mg/l) Sample no. 813 | Treated waste (wastewater) (mg/l) Sample no. 814 |
|---|---|---|---|---|
| Arsenic | 3 | <1 | <1 | <0.1 |
| Cadmium | <5 | <5 | 10 | <0.5 |
| Chromium (hexavalent) | I | I | 807 | 0.12 |
| Chromium (total) | 1800 | 7000 | 2279 | 0.19 |
| Copper | 865 | 306 | 133 | 0.15 |
| Lead | <10 | <10 | 54 | <0.01 |
| Nickel | 3200 | 2600 | 470 | 0.33 |
| Zinc | <2 | <2 | 4 | 0.115 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 9 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-3 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #3

| Constituent | Untreated K062 waste (mg/l) Sample no. 817 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated waste composite[a] (mg/l) Sample no. 821 | Treated waste (wastewater) (mg/l) Sample no. 822 |
|---|---|---|---|---|
| Arsenic | 3 | <1 | <1 | <0.1 |
| Cadmium | <5 | <5 | 5 | <0.5 |
| Chromium (hexavalent) | I | I | 775 | I |
| Chromium (total) | 1700 | 7000 | 1990 | 0.20 |
| Copper | 425 | 306 | 133 | 0.21 |
| Lead | <10 | <10 | <10 | <0.01 |
| Nickel | 100310 | 2600 | 16330 | 0.33 |
| Zinc | 7 | <2 | 3.9 | 0.140 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 10 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-4 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #4

| Constituent | Untreated K062 waste (mg/l) Sample no. 827 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated K062 waste (mg/l) Sample no. 817 | Untreated waste composite[a] (mg/l) Sample no. 829 | Treated waste (wastewater) (mg/l) Sample no. 830 |
|---|---|---|---|---|---|
| Arsenic | 2 | <1 | 3 | <1 | <1 |
| Cadmium | <5 | <5 | 5 | <5 | <0.5 |
| Chromium (hexavalent) | 1 | I | I | 0.6 | 0.042 |
| Chromium (total) | 142 | 7000 | 1700 | 556 | 0.10 |
| Copper | 42 | 306 | 425 | 88 | 0.07 |
| Lead | <10 | <10 | <10 | <10 | <0.01 |
| Nickel | 650 | 2600 | 41000 | 6610 | 0.33 |
| Zinc | 3 | <2 | 7 | 84 | 1.62 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 9 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-5 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #5

| Constituent | Untreated K062 waste (mg/l) Sample no. 801 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated K062 waste (mg/l) Sample no. 817 | Untreated waste composite[a] (mg/l) Sample no. 837 | Treated waste (wastewater) (mg/l) Sample no. 838 |
|---|---|---|---|---|---|
| Arsenic | 3 | <1 | 3 | <1 | <0.1 |
| Cadmium | <5 | <5 | 5 | <5 | <0.5 |
| Chromium (hexavalent) | I | I | I | 917 | 0.058 |
| Chromium (total) | 1800 | 7000 | 1700 | 2236 | 0.11 |
| Copper | 865 | 306 | 425 | 91 | 0.14 |
| Lead | <10 | <10 | <10 | 18 | 0.01 |
| Nickel | 3200 | 2600 | 41000 | 1414 | 0.31 |
| Zinc | <2 | <2 | 7 | 71 | 0.125 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 8 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-6 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #6

| Constituent | Untreated K062 waste (mg/l) Sample no. 801 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated waste composite[a] (mg/l) Sample no. 845 | Treated waste (wastewater) (mg/l) Sample no. 846 |
|---|---|---|---|---|
| Arsenic | 3 | <1 | <1 | <0.1 |
| Cadmium | <5 | <5 | <5 | <0.5 |
| Chromium (hexavalent) | I | I | 734 | I |
| Chromium (total) | 1800 | 7000 | 2548 | 0.10 |
| Copper | 865 | 306 | 149 | 0.12 |
| Lead | <10 | <10 | <10 | <0.01 |
| Nickel | 3200 | 2600 | 588 | 0.33 |
| Zinc | <2 | <2 | 4 | 0.095 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 8 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-7 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #7

| Constituent | Untreated K062 waste (mg/l) Sample no. 801 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated waste composite[a] (mg/l) Sample no. 853 | Treated waste (wastewater) (mg/l) Sample no. 854 |
|---|---|---|---|---|
| Arsenic | 3 | <1 | <1 | <0.1 |
| Cadmium | <5 | <5 | 10 | <0.5 |
| Chromium (hexavalent) | I | I | 769 | 0.12 |
| Chromium (total) | 1800 | 7000 | 2314 | 0.12 |
| Copper | 865 | 306 | 72 | 0.16 |
| Lead | <10 | <10 | 108 | <0.01 |
| Nickel | 3200 | 2600 | 426 | 0.40 |
| Zinc | <2 | <2 | 171 | 0.115 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 9 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-8 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #8

| Constituent | Untreated K062 waste (mg/l) Sample no. 859 | Untreated K062 waste (mg/l) Sample no. 801 | Untreated waste composite[a] (mg/l) Sample no. 861 | Treated waste (wastewater) (mg/l) Sample no. 862 |
|---|---|---|---|---|
| Arsenic | <1 | 3 | <1 | <0.1 |
| Cadmium | <5 | <5 | <5 | <0.5 |
| Chromium (hexavalent) | 0.220 | I | 0.13 | <0.01 |
| Chromium (total) | 15 | 1800 | 831 | 0.15 |
| Copper | 151 | 865 | 217 | 0.16 |
| Lead | <10 | <10 | 212 | <0.01 |
| Nickel | 90 | 3200 | 669 | 0.36 |
| Zinc | 7 | 9 | 151 | 0.13 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 9 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.



3183g

Table 4-9 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #9

| Constituent | Untreated K062 waste (mg/l) Sample no. 867 | Untreated K062 waste (mg/l) Sample no. 801 | Untreated K062 waste (mg/l) Sample no. 802 | Untreated waste composite[a] (mg/l) Sample no. 869 | Treated waste (wastewater (mg/l) Sample no. 870 |
|---|---|---|---|---|---|
| Arsenic | <0.1 | 3 | <1 | <1 | <0.1 |
| Cadmium | <0.5 | <5 | <5 | <5 | <0.5 |
| Chromium (hexavalent) | 0.079 | I | I | 0.07 | 0.041 |
| Chromium (total) | 6 | 1800 | 7000 | 939 | 0.10 |
| Copper | 5 | 865 | 306 | 225 | 0.08 |
| Lead | <1 | <10 | <10 | <10 | <0.01 |
| Nickel | 4 | 3200 | 2600 | 940 | 0.33 |
| Zinc, | 0.4 | <2 | <2 | 5 | 0.06 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 10 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-10 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #10

| Constituent | Untreated K062 waste (mg/l) Sample no. 801 | Untreated waste composite[a] (mg/l) Sample no. 885 | Treated waste (wastewater) (mg/l) Sample no. 862 |
|---|---|---|---|
| Arsenic | <3 | <1 | <0.10 |
| Cadmium | <5 | <5 | <0.5 |
| Chromium (hexavalent) | I | 0.08 | 0.106 |
| Chromium (total) | 1800 | 395 | 0.12 |
| Copper | 865 | 191 | 0.14 |
| Lead | <10 | <10 | <0.01 |
| Nickel | 3200 | 712 | 0.33 |
| Zinc | <2 | 5 | 0.070 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 9 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

Table 4-11 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #11

| Constituent | Untreated K062 waste (mg/l) Sample no. 801 | Untreated K062 waste (mg/l) Sample no. 859 | Untreated waste composite[a] (mg/l) Sample no. 893 | Treated waste (wastewater) (mg/l) Sample no. 894 |
|---|---|---|---|---|
| Arsenic | 3 | <1 | <1 | <0.10 |
| Cadmium | <5 | <5 | 23 | <5 |
| Chromium (hexavalent) | I | 0.220 | 0.30 | <0.01 |
| Chromium (total) | 1800 | 15 | 617 | 0.18 |
| Copper | 865 | 151 | 137 | 0.24 |
| Lead | <10 | <10 | 136 | <0.01 |
| Nickel | 3200 | 90 | 382 | 0.39 |
| Zinc | <2 | 7 | 135 | 0.100 |

Design and Operating Data

| | Design value | Operating value |
|---|---|---|
| pH | 8-10 | 9 |

I = Color interference.

[a]The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Reference: USEPA 1988b.

# 5. IDENTIFICATION OF THE BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section presents the rationale for the determination of best demonstrated available technology (BDAT) for F006 wastewaters. The Agency examines all the available data for the demonstrated technologies to determine whether one of the technologies performs significantly better than the others. Next, the "best" performing treatment technology is evaluated to determine whether the resulting treatment is "available." To be "available," a technology (1) must provide substantial treatment and (2) must be commercially available to the affected industry. If the "best" technology is "available," then the technology represents BDAT.

Based on available performance data for metals and cyanides, the Agency has identified treatment by alkaline chlorination for cyanides and hexavalent chromium reduction, chemical precipitation using lime and sulfides, and sludge dewatering for metals as BDAT for F006 wastewaters. The rationale is provided below.

## 5.1 BDAT Treatment for Metals

For metals in F006 wastewaters, the Agency has identified hexavalent chromium reduction followed by chemical precipitation using lime and sulfides, and sludge dewatering as BDAT. This determination is based on performance data used to develop metals treatment standards for K062 wastewaters. The Agency believes that K062 wastewaters are more difficult to treat than F006 wastewaters because of the high acidity of K062 and the higher concentrations of dissolved metals. Therefore, the same level of performance achievable for K062 wastewaters is expected to be achievable for F006 wastewaters. The performance data used by the Agency are for treatment of a metal-bearing F006, K062, D002, and D003 wastewater by hexavalent chromium reduction using sodium bisulfite, chemical precipitation using lime and sulfides and sludge dewatering, as

discussed in Section 4. The Agency does not expect the use of other treatment chemicals to improve the level of performance. Thus, the treatment train of hexavalent chromium reduction using sodium bisulfite, chemical precipitation using lime and sulfides and sludge dewatering is considered "best." This technology is also "available" because such treatment is commercially available and would provide substantial treatment for metals in F006 wastewaters. Having screened the data, EPA based its determination of substantial treatment on the fact that there were significant reductions in the concentrations of cadmium, chromium, lead, and nickel in the metal-bearing F006, K062, D002, and D003 wastewater for which performance data were available (see Section 4).

Since hexavalent chromium reduction followed by chemical precipitation and sludge dewatering is demonstrated, best, and available, this treatment is considered BDAT for metals in F006 wastewaters. A detailed discussion pertaining to the use of this technology for treatment of K062 wastewaters is included in Section 5 of the K062 background document (USEPA 1988b).

## 5.2 BDAT Treatment for Cyanides

For cyanides in F006 wastewaters, the Agency has identified alkaline chlorination as BDAT, based on performance data used to develop treatment standards for F007, F008, and F009 wastewaters. The Agency believes that the F006 wastewaters contain concentrations of amenable and total cyanides lower than or similar to those in F007, F008, and F009 wastewaters and are therefore less difficult to treat. Based on this information, alkaline chlorination is considered "best." This technology is also "available" because such treatment is commercially available and would provide substantial treatment for cyanides in F006 wastewaters.

Since alkaline chlorination is demonstrated, best, and available, this treatment is considered BDAT for cyanides in F006 wastewaters. A detailed discussion pertaining to the selection of alkaline chlorination as BDAT for F007, F008 and F009 wastewaters is included in Section 5 of the background document for cyanides (USEPA 1989a).

# 6. SELECTION OF REGULATED CONSTITUENTS

This section describes the process used to select the constituents to be regulated in F006 wastewaters. The process involves developing a list of potential regulated constituents and then eliminating those constituents that would not be treated by the chosen BDAT or that would be controlled by regulation of the remaining constituents.

As discussed in the original background document for F006, the Agency has developed a list of hazardous constituents from which the constituents to be regulated are selected. EPA may revise this list as additional data and information become available. The list is divided into the following categories: volatile organics, semivolatile organics, metals, inorganics other than metals, organochlorine pesticides, phenoxyacetic acid herbicides, organophosphorous insecticides, PCBs, and dioxins and furans.

## 6.1 Identification of BDAT List Constituents

As discussed in Sections 2 and 4, the Agency has performance and waste characterization data applicable to F006 wastewaters. These data were used to determine which BDAT list constituents may be present in the waste and thus which ones are potential candidates for regulation in F006 wastewaters.

## 6.2 Constituents Selected for Regulation

For F006 wastewaters, the Agency is proposing to regulate total and amenable cyanides, cadmium, total chromium, lead, and nickel. These constituents were also regulated in F006 nonwastewaters. However, the Agency is not proposing to regulate silver (which was regulated for F006 nonwastewaters) because available performance and waste characterization data indicate that silver is typically present only at untreatable

concentrations in F006 wastewaters. Additionally, the Agency believes that if silver is present in high concentrations in a F006 wastewater, silver recovery will be utilized because of the value of silver. Other BDAT list constituents that are not regulated are expected to be treated by a well-designed and well-operated treatment system.

# 7. CALCULATION OF BDAT TREATMENT STANDARDS

In this section, the Agency presents its determination of treatment standards using the performance and waste characterization data previously presented. EPA's methodology for developing treatment standards is presented in Section 1 of the original F006 background document (USEPA 1988a). The methodology requires the Agency to first delete any performance data that do not represent a well-designed and well-operated treatment system. Additionally, all data must be adjusted for analytical recoveries.

As described in Section 4, EPA is transferring the metals treatment standards developed for K062 wastewaters to F006 wastewaters. In developing BDAT treatment standards for metal constituents to be regulated, the Agency evaluated performance and waste characterization data from the treatment of a metal-bearing F006, K062, D002, and D003 wastewater (as described in Section 4). These data include 11 sample sets that represent treatment of F006 wastewaters using a well-designed and well-operated treatment system. One data set for cadmium was deleted (Sample Set No. 11) because of an artificially high detection limit of 5 ppm, which deviated from the other 10 data points having detection limits of 0.5. The remaining data sets were adjusted for analytical recoveries as described in EPA's Methodology for Developing BDAT Treatment Standards (USEPA 1989b). Using the accuracy-corrected data, EPA developed treatment standards by averaging the performance data for each constituent and then multiplying the average value by a variability factor that accounts for variations in technology performance, waste characteristics, and laboratory analysis.

The corrected values for the F006 wastewater regulated constituents are presented in Table 7-1. Table 7-2 shows the calculations for the four metals being regulated for F006 wastewaters. These standards

Table 7-1 Calculation of Corrected Values for Regulated Constituents - Treated Wastewater

| Constituent | Treated waste (mg/l) | Percent[a] recovery | Correction factor | Corrected value (mg/l) |
|---|---|---|---|---|
| Cadmium | <0.5 | 87 | 1.15 | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| | <0.5 | | | <0.575 |
| Chromium (total) | 0.12 | 68 | 1.47 | 0.1764 |
| | 0.12 | | | 0.1764 |
| | 0.20 | | | 0.294 |
| | 0.10 | | | 0.147 |
| | 0.11 | | | 0.162 |
| | 0.10 | | | 0.147 |
| | 0.12 | | | 0.1764 |
| | 0.15 | | | 0.2205 |
| | 0.10 | | | 0.147 |
| | 0.12 | | | 0.1764 |
| | 0.18 | | | 0.2646 |
| Lead | <0.01 | 76 | 1.316 | <0.0132 |
| | <0.01 | | | <0.0132 |
| | <0.01 | | | <0.0132 |
| | <0.01 | | | <0.0132 |
| | 0.01 | | | 0.0132 |
| | <0.01 | | | <0.0132 |
| | <0.01 | | | <0.0132 |
| | <0.01 | | | <0.0132 |
| | <0.01 | | | <0.0132 |
| | <0.01 | | | <0.0132 |
| | <0.01 | | | <0.0132 |
| Nickel | 0.33 | 93 | 1.075 | 0.35 |
| | 0.33 | | | 0.35 |
| | 0.33 | | | 0.35 |
| | 0.33 | | | 0.35 |
| | 0.31 | | | 0.33 |
| | 0.33 | | | 0.35 |
| | 0.40 | | | 0.43 |
| | 0.36 | | | 0.39 |
| | 0.33 | | | 0.35 |
| | 0.33 | | | 0.35 |
| | 0.39 | | | 0.42 |

[a]The percent recovery has been taken from Table 7-14 of the Onsite Engineering Report from Horsehead Resource Development Company for K061 (USEPA 1987).



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Table 7-2 Calculation of the Treatment Standards for the Regulated Constituents - Treated Wastewater

| Constituent | Conc. | Mean | VF | Treatment standard total concentration (mg/l) |
|---|---|---|---|---|
| Cadmium | <0.575 | 0.575 | 2.8 [a] | 1.6 |
| | <0.575 | | | |
| | <0.575 | | | |
| | <0.575 | | | |
| | <0.575 | | | |
| | <0.575 | | | |
| | <0.575 | | | |
| | <0.575 | | | |
| | <0.575 | | | |
| | <0.575 | | | |
| Chromium (total) | 0.1765 | .1898 | 1.69 | 0.32 |
| | 0.1765 | | | |
| | 0.2941 | | | |
| | 0.1471 | | | |
| | 0.1618 | | | |
| | 0.1471 | | | |
| | 0.1765 | | | |
| | 0.2206 | | | |
| | 0.1471 | | | |
| | 0.1765 | | | |
| | 0.2647 | | | |
| Lead | <0.0132 | 0.0132 | 2.8[a] | 0.04 |
| | <0.0132 | | | |
| | <0.0132 | | | |
| | <0.0132 | | | |
| | 0.0132 | | | |
| | <0.0132 | | | |
| | <0.0132 | | | |
| | <0.0132 | | | |
| | <0.0132 | | | |
| | <0.0132 | | | |
| | <0.0132 | | | |
| Nickel | 0.3548 | .3685 | 1.20 | 0.44 |
| | 0.3548 | | | |
| | 0.3548 | | | |
| | 0.3548 | | | |
| | 0.3333 | | | |
| | 0.3548 | | | |
| | 0.4301 | | | |
| | 0.3871 | | | |
| | 0.3548 | | | |
| | 0.3548 | | | |
| | 0.4194 | | | |

[a] For cases in which all values are at or below the detection limit, the variability factor is taken as 2.8.

represent instantaneous maximum concentrations that must be achieved as a prerequisite for land disposal. The concentrations are in mg/l (parts per million on a weight-per-volume basis). A detailed discussion on the calculation of these metals treatment standards can be found in Section 7 of the K062 background document (USEPA 1988b).

The proposed amenable and total cyanide treatment standards were transferred from the cyanide treatment standards developed for F007, F008, and F009 wastewaters based on alkaline chlorination. Because F006 wastewaters contain concentrations of amenable and total cyanides lower than or similar to those in these wastewaters, the Agency believes that F006 wastewaters are less difficult to treat.

Table 7-3 is a summary of accuracy adjustment data for total cyanides. Table 7-4 shows the calculation of the treatment standards for cyanides in F006 wastewaters. To calculate the treatment standard for amenable cyanides, the Agency has taken into account the precision of the analytical methods for cyanide analysis based on the performance of alkaline chlorination.

Table 7-3 Summary of Accuracy Adjustment of Treatment Data
for Total Cyanide in Electroplating Wastes

| | Untreated waste concentration (mg/l) | Measured treated waste concentration (mg/l) | Percent recovery for matrix spike test | Accuracy-correction factor | Accuracy-adjusted concentration (mg/l) |
|---|---|---|---|---|---|
| Alkaline Chlorination | | | | | |
| Sample Set No. 1 | 71,759 | 0.95 | 94 | 1.06 | 1.01 |
| Sample Set No. 2 | 12,000 | 0.95 | 94 | 1.06 | 1.01 |
| Sample Set No. 3 | 17,206 | <0.014 | 94 | 1.06 | <0.015 |
| Sample Set No. 4 | 25,936 | <0.014 | 94 | 1.06 | <0.015 |
| Sample Set No. 5 | 16,914 | <0.014 | 94 | 1.06 | <0.015 |
| Sample Set No. 6 | 59,421 | 0.028 | 94 | 1.06 | 0.030 |
| Sample Set No. 7 | 31,994 | 0.028 | 94 | 1.06 | 0.030 |
| Sample Set No. 8 | 41,900 | <0.014 | 94 | 1.06 | <0.015 |
| Sample Set No. 9 | 18,882 | <0.014 | 94 | 1.06 | <0.015 |
| Sample Set No. 10 | 1,270 | 0.17 | 94 | 1.06 | 0.18 |
| Sample Set No. 12 | 12,085 | <0.014 | 94 | 1.06 | <0.015 |
| Sample Set No. 13 | 10,902 | 0.070 | 94 | 1.06 | 0.074 |
| Sample Set No. 14 | 16,010 | 0.070 | 94 | 1.06 | 0.074 |

Table 7-4 Calculation of Wastewater Treatment Standards for Total and Amenable Cyanide Based on Alkaline Chlorination

| Regulated constituent (units) | Accuracy-adjusted treatment waste concentration[a] | Mean treated waste concentration | Variability factor (VF) | Treatment standard (total composition) |
|---|---|---|---|---|
| Wastewater (mg/l): | | | | |
| Cyanide (total) | 1.01<br>1.01<br>0.015<br>0.015<br>0.015<br>0.030<br>0.030<br>0.015<br>0.015<br>0.18<br>0.015<br>0.074<br>0.074 | 0.192 | 9.8 | 1.9 |
| Cyanide (amenable) | a | a | a | 0.10 |

[a]To calculate the treatment standard for amenable cyanides, the Agency has taken into account the precision of the analytical methods for cyanide analysis based on the performance of alkaline chlorination.

# 8. REFERENCES


USEPA. 1983. Development Document (Final) for Effluent Limitations Guidelines and New Source Performance Standards for Metals Finishing Point Source Category. U.S. Environmental Protection Agency. EPA 440/1-83-09.

USEPA. 1987. Onsite Engineering Report for Horsehead Resource Development Co., Inc. for K061. Prepared by Versar Inc. for the Office of Solid Waste, U.S. Environmental Protection Agency, under Contract No. 68-01-7053

USEPA. 1988a. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for F006. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988b. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K062. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989a. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for cyanide wastes. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989b. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for developing BDAT treatment standards. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989c. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment technology background document. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989d. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for wastewaters containing BDAT list constituents. Washington, D.C.: U.S. Environmental Protection Agency.

# ATTACHMENT A

WASTE CHARACTERIZATION DATA FOR F006 WASTEWATERS
COLLECTED BY EPA'S OFFICE OF WATER FOR THE
EFFLUENT LIMITATIONS GUIDELINES FOR THE
METAL FINISHING INDUSTRY (USEPA 1983)

TABLE 5-18

POLLUTANTS FOUND IN TOTAL PLANT RAW WASTE
DISCHARGED TO END-OF-PIPE TREATMENT

| PARAMETER | Flow Proportioned Mean Concentration, mg/l |
|---|---|
| 114. Antimony | 0.009 |
| 115. Arsenic | 0.008 |
| 117. Beryllium | 0.001 |
| 118. Cadmium | 0.283 |
| 119. Chromium | 27.46 |
| Chromium, Hexavalent | 0.931 |
| 120. Copper | 12.63 |
| 121. Cyanide | 1.856 |
| Cyanide, Amenable to Chlorination | 1.168 |
| 122. Lead | 0.331 |
| 123. Mercury | 0.001 |
| 124. Nickel | 15.47 |
| 125. Selenium | 0.001 |
| 126. Silver | 0.023 |
| 127. Thallium | 0.009 |
| 128. Zinc | 12.47 |
| Oil and Grease | 391.60 |
| Total Suspended Solids | 539.09 |

TABLE 5-19
POLLUTANT CONCENTRATIONS FOUND IN THE
COMMON METALS RAW WASTE STREAM
(Average Daily Values (mg/liter)

| Toxic Pollutant | Minimum | Maximum | Mean | Median | # Zeros | # Points | Flow Proportioned Mean Concentration |
|---|---|---|---|---|---|---|---|
| 114 Antimony | 0.0 | 0.430 | 0.007 | 0.0 | 84 | 106 | .0007 |
| 115 Arsenic | 0.0 | 0.064 | 0.005 | 0.0 | 75 | 105 | 0.015 |
| 117 Beryllium | 0.0 | 0.044 | 0.008 | 0.005 | 4 | 27 | 0.016 |
| 118 Cadmium | 0.0 | 21.5 | 0.613 | 0.001 | 48 | 119 | 0.070 |
| 119 Chromium | 0.0 | 35.4 | 2.10 | 0.105 | 16 | 116 | 1.39 |
| 120 Copper | 0.0 | 500. | 14.2 | 0.175 | 3 | 119 | 1.84 |
| 121 Cyanide | 0.0 | 2370. | 42.1 | 0.016 | 29 | 99 | 0.834 |
| 122 Lead | 0.0 | 42.3 | 1.25 | 0.053 | 35 | 122 | 0.738 |
| 123 Mercury | 0.0 | 0.400 | 0.005 | 0.0 | 67 | 109 | 0.001 |
| 124 Nickel | 0.0 | 415. | 19.4 | 0.078 | 20 | 111 | 4.16 |
| 125 Selenium | 0.0 | 0.060 | 0.007 | 0.005 | 5 | 26 | 0.003 |
| 126 Silver | 0.0 | 0.080 | 0.006 | 0.0 | 59 | 103 | 0.001 |
| 127 Thallium | 0.0 | 0.062 | 0.008 | 0.003 | 5 | 26 | 0.003 |
| 128 Zinc | 0.0 | 16,500. | 312. | 0.393 | 1 | 122 | 41.3 |
| Aluminum | 0.0 | 200. | 27.4 | 1.27 | 2 | 16 | 85.6 |
| Barium | 0.0 | 0.017 | 0.032 | 0.029 | 1 | 4 | 0.031 |
| Boron | 1.67 | 4.0 | 31.4 | 3.76 | 0 | 3 | 3.13 |
| Calcium | 25.0 | 76.2 | 51.4 | 52.2 | 0 | 4 | 58.5 |
| Cobalt | 0.0 | 0.023 | 0.007 | 0.0 | 4 | 7 | 0.010 |
| Fluorides | 0.0 | 36.1 | 4.31 | 0.876 | 9 | 99 | 6.15 |
| Iron | 0.0 | 13,100. | 500. | 2.44 | 1 | 102 | 84.7 |
| Magnesium | 5.6 | 31.1 | 16.1 | 13.8 | 0 | 4 | 17.4 |
| Manganese | 0.059 | 0.500 | 0.233 | 0.085 | 0 | 7 | 0.337 |
| Molybdenum | 0.0 | 0.300 | 0.102 | 0.018 | 1 | 6 | 0.109 |
| Phosphorus | 0.0 | 76.7 | 7.72 | 3.06 | 1 | 98 | 8.00 |
| Sodium | 16.7 | 310. | 151. | 138. | 0 | 4 | 211. |
| Tin | 0.0 | 14.7 | 1.04 | 0.0 | 60 | 98 | 3.35 |
| Titanium | 0.0 | 4.30 | 0.493 | 0.006 | 4 | 9 | 0.046 |
| Vanadium | 0.0 | 0.216 | 0.066 | 0.023 | 1 | 4 | 0.069 |
| Yttrium | 0.0 | 0.020 | 0.010 | 0.010 | 1 | 4 | 0.010 |
| Oil and Grease | 4.70 | 802,000. | 40,700. | 6,060. | 0 | 37 | 11,600. |

TABLE 5-20
POLLUTANT CONCENTRATIONS FOUND IN THE
PRECIOUS METALS RAW WASTE STREAM

Average Daily Values (mg/liter)

| Toxic Pollutant | Minimum | Maximum | Mean | Median | # Zeros | # Points | Flow Proportioned Mean Concentration |
|---|---|---|---|---|---|---|---|
| 126 Silver | 0.0 | 600. | 69.0 | 0.243 | 3 | 15 | 8.09 |
| Gold | 0.0 | 42.7 | 9.27 | 0.560 | 6 | 15 | 6.11 |
| Palladium | 0.0 | 0.120 | 0.023 | 0.0 | 10 | 13 | 0.003 |
| Rhodium | 0.0 | 0.220 | 0.018 | 0.0 | 11 | 12 | 0.005 |



A-4

TABLE 5-21
POLLUTANT CONCENTRATIONS FOUND IN THE
COMPLEXED METALS RAW WASTE STREAM

Average Daily Values (mg/liter)

| Toxic Pollutant | Minimum | Maximum | Mean | Median | # Zeros | # Points | Flow Proportioned Mean Concentration |
|---|---|---|---|---|---|---|---|
| 118 Cadmium | 0.0 | 3.65 | 0.247 | 0.0 | 22 | 31 | 0.173 |
| 120 Copper | 0.0 | 62.6 | 10.3 | 5.90 | 3 | 31 | 9.68 |
| 122 Lead | 0.0 | 3.61 | 0.372 | 0.0 | 21 | 31 | 0.240 |
| 124 Nickel | 0.0 | 294. | 22.5 | 0.550 | 6 | 31 | 18.8 |
| 128 Zinc | 0.023 | 17.6 | 3.05 | 0.210 | 0 | 31 | 2.52 |

# ATTACHMENT B

PERFORMANCE DATA FOR F006 WASTEWATERS
COLLECTED BY EPA'S OFFICE OF WATER FOR THE
EFFLUENT LIMITATIONS GUIDELINES FOR THE
METAL FINISHING INDUSTRY (USEPA 1983)

TABLE 7-4

METAL FINISHING CATEGORY PERFORMANCE DATA FOR CADMIUM

OPTION 1

| Data Point | Raw Waste Concentration (mg/l) | Effluent Concentration (mg/l) | Plant ID |
|---|---|---|---|
| 1. | 0.012 | 0.006 | 20083-1-5 |
| 2. | 0.012 | 0.006 | 20083-1-6 |
| 3. | 0.012 | 0.006 | 19063-1-2 |
| 4. | 0.013 | 0.005 | 6083-1-2 |
| 5. | 0.013 | 0.005 | 19063-1-3 |
| 6. | 0.013 | 0.010 | 15070-1-1 |
| 7. | 0.015 | 0.008 | 6731-1-1 |
| 8. | 0.017 | 0.006 | 6731-1-2 |
| 9. | 0.019 | 0.007 | 6731-1-3 |
| 10. | 0.021 | 0.010 | 6074-1-1 |
| 11. | 0.021 | 0.018 | 31020-1-1 |
| 12. | 0.022 | 0.013 | 6087-1-3 |
| 13. | 0.022 | 0.019 | 27044-1-0 |
| 14. | 0.024 | 0.005 | 20080-1-1 |
| 15. | 0.030 | 0.014 | 6087-1-1 |
| 16. | 0.032 | 0.005 | 4065-8-1 |
| 17. | 0.033 | 0.011 | 6074-1-1 |
| 18. | 0.037 | 0.005 | 20073-1-1 |
| 19. | 0.037 | 0.005 | 20073-1-2 |
| 20. | 0.042 | 0.006 | 36041-1-2 |
| 21. | 0.042 | 0.006 | 36041-1-3 |
| 22. | 0.053 | 0.009 | 36041-1-1 |
| 23. | 0.068 | 0.017 | 21003-15-2 |
| 24. | 0.077 | 0.005 | 33024-6-0 |
| 25. | 0.084 | 0.027 | 21003-15-0 |
| 26. | 0.087 | 0.024 | 21003-15-1 |
| 27. | 0.113 | 0.028 | 6051-6-0 |
| 28. | 0.250 | 0.008 | 15070-1-2 |
| 29. | 0.925 | 0.012 | 20086-1-1 |
| 30. | 1.00 | 0.015 | 20086-1-3 |
| 31. | 1.88 | 0.018 | 20086-1-2 |
| Mean Concentration | 0.162 (n=31) | 0.011 (n=31) | |

TABLE 7-5

METAL FINISHING CATEGORY PERFORMANCE DATA FOR CHROMIUM (TOTAL)

OPTION 1

| Data Point | Raw Waste Concentration (mg/l) | Effluent Concentration (mg/l) | Plant ID |
|---|---|---|---|
| 1. | 0.65 | 0.052 | 6087-1-3 |
| 2. | 1.09 | 0.128 | 6731-1-2 |
| 3. | 1.20 | 1.12 | 15010-12-3 |
| 4. | 1.30 | 0.013 | 19068-15-1 |
| 5. | 1.31 | 0.014 | 4069-8-1 |
| 6. | 1.51 | 0.150 | 44062-15-0 |
| 7. | 1.56 | 0.255 | 6051-6-0 |
| 8. | 1.60 | 0.120 | 44062-15-1 |
| 9. | 1.70 | 1.16 | 15010-12-2 |
| 10. | 2.00 | 0.040 | 11477-22-2 |
| 11. | 2.43 | 0.070 | 33024-6-0 |
| 12. | 4.34 | 0.039 | 44062-15-2 |
| 13. | 7.00 | 0.020 | 11477-22-1 |
| 14. | 12.2 | 0.556 | 6083-1-2 |
| 15. | 12.2 | 0.611 | 36041-1-2 |
| 16. | 14.0 | 0.250 | 33065-9-1 |
| 17. | 21.6 | 0.005 | 19068-14-0 |
| 18. | 24.7 | 0.333 | 36040-1-1 |
| 19. | 25.0 | 0.333 | 36041-1-3 |
| 20. | 25.3 | 0.533 | 36040-1-1 |
| 21. | 28.6 | 0.667 | 36041-1-1 |
| 22. | 29.4 | 0.733 | 36040-1-1 |
| 23. | 32.2 | 0.0 | 19068-15-2 |
| 24. | 58.2 | 0.833 | 20086-1-2 |
| 25. | 69.3 | 1.06 | 20086-1-3 |
| 26. | 70.3 | 0.833 | 20086-1-1 |
| 27. | 76.7 | 1.64 | 20078-1-7 |
| 28. | 85.3 | 0.143 | 6074-1-1 |
| 29. | 98.0 | 0.333 | 6074-1-1 |
| 30. | 104. | 0.714 | 6074-1-1 |
| 31. | 116. | 0.018 | 31020-1-1 |
| 32. | 117. | 0.400 | 20078-1-2 |
| 33. | 117. | 0.500 | 20078-1-3 |
| 34. | 142. | 0.195 | 20080-1-1 |
| 35. | 162. | 1.47 | 20073-1-1 |
| 36. | 175. | 1.89 | 20073-1-2 |
| 37. | 190. | 2.36 | 40062-8-0 |
| 38. | 393. | 2.14 | 40062-8-0 |
| Mean Concentration | 58.6 (n=38) | 0.572 (n=38) | |

TABLE 7-7

METAL FINISHING CATEGORY PERFORMANCE DATA FOR LEAD

OPTION 1

| Data Point | Raw Waste Concentration (mg/l) | Effluent Concentration (mg/l) | Plant ID |
|---|---|---|---|
| 1. | 0.052 | 0.048 | 15070-1-3 |
| 2. | 0.054 | 0.033 | 36040-1-1 |
| 3. | 0.064 | 0.025 | 20078-1-3 |
| 4. | 0.067 | 0.013 | 6731-1-3 |
| 5. | 0.071 | 0.0 | 19068-15-1 |
| 6. | 0.072 | 0.044 | 15070-1-1 |
| 7. | 0.072 | 0.048 | 15070-1-2 |
| 8. | 0.075 | 0.010 | 20080-1-1 |
| 9. | 0.084 | 0.025 | 20078-1-2 |
| 10. | 0.102 | 0.025 | 20078-1-4 |
| 11. | 0.103 | 0.077 | 4065-8-1 |
| 12. | 0.125 | 0.050 | 20083-1-3 |
| 13. | 0.136 | 0.032 | 36041-1-2 |
| 14. | 0.136 | 0.040 | 20078-1-7 |
| 15. | 0.144 | 0.032 | 20083-1-6 |
| 16. | 0.145 | 0.038 | 20073-1-1 |
| 17. | 0.154 | 0.044 | 20086-1-3 |
| 18. | 0.160 | 0.036 | 20086-1-1 |
| 19. | 0.164 | 0.040 | 20086-1-2 |
| 20. | 0.168 | 0.032 | 20083-1-5 |
| 21. | 0.174 | 0.0 | 19068-15-2 |
| 22. | 0.182 | 0.044 | 6074-1-1 |
| 23. | 0.212 | 0.036 | 36041-1-3 |
| 24. | 0.218 | 0.044 | 6074-1-1 |
| 25. | 0.226 | 0.025 | 20073-1-2 |
| 26. | 0.233 | 0.0 | 36623-15-2 |
| 27. | 0.270 | 0.160 | 4071-15-3 |
| 28. | 0.364 | 0.067 | 27044-1-0 |
| 29. | 0.394 | 0.021 | 33065-9-1 |
| 30. | 0.474 | 0.043 | 40062-8-0 |
| 31. | 0.567 | 0.0 | 36623-15-0 |
| 32. | 0.600 | 0.036 | 40062-8-0 |
| 33. | 0.800 | 0.068 | 31020-1-1 |
| 34. | 0.909 | 0.073 | 15010-12-2 |
| 35. | 1.000 | 0.064 | 36041-1-1 |

(Continued)

TABLE 7-7 (Continued)

METAL FINISHING CATEGORY PERFORMANCE DATA FOR LEAD

OPTION 1

| Data Point | Raw Waste Concentration (mg/l) | Effluent Concentration (mg/l) | Plant ID |
|---|---|---|---|
| 36. | 1.000 | 0.085 | 6087-1-1 |
| 37. | 1.000 | 0.133 | 15010-12-3 |
| 38. | 1.120 | 0.065 | 6087-1-3 |
| 39. | 2.500 | 0.160 | 6083-1-2 |
| 40. | 2.540 | 0.0 | 12061-15-2 |
| 41. | 6.928 | 0.165 | 19063-1-1 |
| 42. | 6.930 | 0.0 | 12061-15-0 |
| 43. | 8.362 | 0.098 | 19063-1-2 |
| 44. | 9.701 | 0.143 | 19063-1-3 |
| Mean Concentration | 1.11 (n=44) | 0.0505 (n=44) | |

TABLE 7-8

METAL FINISHING CATEGORY PERFORMANCE DATA FOR NICKEL

OPTION 1

| Data Point | Raw Waste Concentration (mg/l) | Effluent Concentration (mg/l) | Plant ID |
|---|---|---|---|
| 1. | 1.07 | 0.076 | 19063-1-1 |
| 2. | 1.44 | 1.11 | 6731-1-1 |
| 3. | 1.48 | 0.150 | 21003-15-1 |
| 4. | 1.69 | 0.060 | 19063-1-2 |
| 5. | 2.14 | 0.342 | 4069-8-1 |
| 6. | 2.22 | 1.00 | 6731-1-2 |
| 7. | 2.23 | 0.190 | 19063-1-3 |
| 8. | 2.57 | 0.044 | 36041-1-2 |
| 9. | 3.20 | 0.726 | 27044-1-0 |
| 10. | 3.24 | 0.700 | 36623-15-2 |
| 11. | 3.87 | 0.122 | 4069-8-1 |
| 12. | 3.89 | 1.89 | 6731-1-3 |
| 13. | 4.49 | 0.571 | 36041-1-3 |
| 14. | 5.00 | 0.320 | 36041-1-1 |
| 15. | 5.42 | 1.20 | 36623-15-0 |
| 16. | 5.60 | 0.414 | 5020-1-6 |
| 17. | 5.80 | 1.03 | 36623-15-1 |
| 18. | 6.80 | 0.414 | 5020-1-5 |
| 19. | 7.31 | 0.759 | 5020-1-4 |
| 20. | 8.56 | 0.0 | 19068-15-2 |
| 21. | 9.33 | 2.27 | 6083-1-2 |
| 22. | 11.8 | 0.294 | 5020-1-3 |
| 23. | 27.5 | 0.120 | 31020-1-1 |
| 24. | 33.9 | 0.536 | 20086-1-2 |
| 25. | 36.7 | 0.464 | 20086-1-3 |
| 26. | 42.9 | 0.786 | 20086-1-1 |
| 27. | 50.0 | 7.30 | 6087-1-1 |
| 28. | 52.5 | 0.478 | 20073-1-2 |
| 29. | 53.8 | 0.448 | 20073-1-1 |
| 30. | 73.0 | 6.39 | 6087-1-3 |
| 31. | 76.9 | 0.381 | 20078-1-7 |
| 32. | 78.7 | 0.106 | 20078-1-3 |
| 33. | 78.7 | 0.427 | 20078-1-4 |
| 34. | 80.6 | 1.84 | 40062-8-0 |
| 35. | 85.3 | 0.144 | 20078-1-2 |

(Continued)

TABLE 7-8 (Continued)

METAL FINISHING CATEGORY PERFORMANCE DATA FOR NICKEL

OPTION 1

| Data Point | Raw Waste Concentration (mg/l) | Effluent Concentration (mg/l) | Plant ID |
|---|---|---|---|
| 36. | 94.3 | 0.600 | 6074-1-1 |
| 37. | 94.4 | 1.52 | 40062-8-0 |
| 38. | 97.1 | 0.808 | 20083-1-5 |
| 39. | 108. | 0.778 | 36040-1-1 |
| 40. | 108 | 1.78 | 36040-1-1 |
| 41. | 111. | 0.462 | 20083-1-6 |
| 42. | 128. | 0.571 | 6074-1-1 |
| 43. | 142. | 1.56 | 36040-1-1 |
| 44. | 153. | 0.907 | 20083-1-3 |
| 45. | 167. | 0.304 | 6074-1-1 |
| Mean Concentration | 46.1 (n=45) | 0.942 (n=45) | |

TABLE 7-11

TREATMENT OF COMMON METALS - VISITED PLANTS
SUMMARY OF OPTION 1 MEAN EFFLUENT CONCENTRATIONS

| Parameter | Mean Concentration (mg/ℓ) |
|---|---|
| Cadmium | 0.011 |
| Chromium, Total | 0.572 |
| Copper | 0.815 |
| Lead | 0.051 |
| Nickel | 0.942 |
| Zinc | 0.549 |
| Total Suspended Solids | 16.8 |

TABLE 7-13
EFFLUENT CADMIUM SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 1 SYSTEMS

| Plant ID | Number OF Points | Mean Effluent Concentration (mg/l) | Variability Factor Daily | Variability Factor 10-Day |
|---|---|---|---|---|
| 1067 | 222 | 0.13 | 3.08 | 2.04 |
| 6002 | 6 | 0.05 | 7.48 | -- |
| 6035 | 9 | 0.01 | -- | -- |
| 6051 | 13 | 0.04 | -- | 1.14 |
| 11008 | 185 | 0.12 | 3.14 | 2.01 |
| 47025 | 50 | 0.21 | 7.49 | 8.54 |
| OVERALL | 485(Total) | 0.13(Mean) | 5.31(Median) | 2.02(Median) |

TABLE 7-14
EFFLUENT TOTAL CHROMIUM SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 1 SYSTEMS

| Plant ID | Number OF Points | Mean Effluent Concentration (mg/l) | Variability Factor | |
|---|---|---|---|---|
| | | | Daily | 10-Day |
| 1067 | 230 | 0.17 | 3.07 | 2.27 |
| 5020 | 228 | 0.03 | -- | 10.52 |
| 6002 | 6 | 0.74 | 13.66 | -- |
| 6035 | 12 | 0.18 | 7.52 | 1.89 |
| 6051 | 13 | 0.27 | 3.97 | 1.78 |
| 6053 | 12 | 0.14 | 8.72 | 3.02 |
| 6087 | 12 | 0.02 | -- | -- |
| 6107 | 10 | 0.10 | 5.58 | -- |
| 6111 | 3 | 0.12 | 5.57 | -- |
| 11008 | 185 | 0.09 | 5.97 | 4.08 |
| 17030 | 344 | 0.20 | 6.84 | 5.56 |
| 19063 | 238 | 0.16 | 3.51 | 4.80 |
| 20080 | 269 | 0.29 | 4.58 | 2.63 |
| 20082 | 253 | 0.60 | 5.20 | 3.70 |
| 20116 | 243 | 0.21 | 2.76 | 1.65 |
| 22735 | 35 | 0.15 | 4.64 | 1.39 |
| 23076 | 242 | 0.40 | 4.79 | 4.41 |
| 30050 | 289 | 0.01 | 3.80 | 3.07 |
| 30090 | 49 | 0.04 | 4.90 | 2.12 |
| 36040 | 224 | 0.24 | 1.67 | 1.30 |
| 44150 | 42 | 0.01 | -- | 37.26 |
| 45741 | 358 | 0.06 | 4.47 | 2.98 |
| 47025 | 255 | 0.06 | 5.57 | 2.81 |
| OVERALL | 3552(Total) | 0.19(Mean) | 4.85(Median) | 2.98(Median) |

TABLE 7-16
EFFLUENT LEAD SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 1 SYSTEMS

| Plant ID | Number OF Points | Mean Effluent Concentration (mg/l) | Variability Factor | |
|---|---|---|---|---|
| | | | Daily | 10-Day |
| 5020 | 229 | 0.242 | 4.50 | 2.11 |
| 19063 | 238 | 0.10 | 3.15 | 3.18 |
| 30165 | 65 | 0.45 | 2.66 | 1.93 |
| 44045 | 49 | 0.14 | 3.89 | 2.26 |
| OVERALL | 581(Total) | 0.20(Mean) | 3.52(Median) | 2.19(Median) |

TABLE 7-17
EFFLUENT NICKEL SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 1 SYSTEMS

| Plant ID | Number OF Points | Mean Effluent Concentration (mg/l) | Variability Factor | |
|---|---|---|---|---|
| | | | Daily | 10-Day |
| 1067 | 230 | 0.21 | 4.05 | 2.39 |
| 5020 | 231 | 0.40 | 4.48 | 2.54 |
| 6002 | 6 | 0.09 | 4.72 | -- |
| 6035 | 9 | 0.06 | 5.37 | -- |
| 6051 | 13 | 0.04 | 6.55 | 6.12 |
| 6087 | 12 | 0.66 | -- | 6.30 |
| 11008 | 185 | 0.44 | 2.79 | 1.62 |
| 19063 | 10 | 0.07 | 2.90 | -- |
| 20082 | 253 | 0.32 | 3.72 | 2.77 |
| 20116 | 243 | 0.67 | 2.26 | 1.31 |
| 23076 | 241 | 0.50 | 6.38 | 4.29 |
| 30050 | 75 | 0.03 | 3.78 | 2.37 |
| 33092 | 27 | 0.25 | 4.38 | 2.51 |
| 36040 | 178 | 0.32 | 1.73 | 1.27 |
| 44045 | 49 | 0.32 | 10.13 | 2.66 |
| 44150 | 42 | 0.12 | -- | -- |
| OVERALL | 1804(Total) | 0.39(Mean) | 4.22(Median) | 2.52(Median) |

TABLE 7-23
TREATMENT OF COMMON METALS
VISITED PLANT OPTION 2 MEAN EFFLUENT CONCENTRATIONS

| Parameter | mg/l |
|---|---|
| Total Suspended Solids | 12.8 |
| Cadmium | .014 |
| Chromium, Total | .319 |
| Copper | .367 |
| Lead | .031 |
| Nickel | .459 |
| Zinc | .247 |

TABLE 7-24
EFFLUENT TSS SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 2 SYSTEMS

| Plant ID | Number Of Points | Mean Effluent Concentration (mg/ℓ) |
|---|---|---|
| 03043 | 94 | 10.07 |
| 15193 | 12 | 13.58 |
| 20483 | 357 | 5.90 |
| 38223 | 234 | 5.74 |
| OVERALL | 697 (TOTAL) | 6.54 (MEAN) |

TABLE 7-25
EFFLUENT CADMIUM SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 2 SYSTEMS

| Plant ID | Number Of Points | Mean Effluent Concentration (mg/ℓ) |
|---|---|---|
| 38223 | 234 | 0.08 |

TABLE 7-26
EFFLUENT CHROMIUM SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 2 SYSTEMS

| Plant ID | Number Of Points | Mean Effluent Concentration (mg/ℓ) |
|---|---|---|
| 03043 | 91 | 0.60 |
| 15193 | 12 | 0.11 |
| 31021 | 86 | 0.25 |
| 38223 | 234 | 0.06 |
| OVERALL | 423 (TOTAL) | 0.22 (MEAN) |

TABLE 7-27
EFFLUENT COPPER SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 2 SYSTEMS

| Plant ID | Number Of Points | Mean Effluent Concentration (mg/ℓ) |
|---|---|---|
| 11125 | 29 | 1.11 |
| 15193 | 12 | 0.06 |
| 31021 | 121 | 1.44 |
| OVERALL | 225 (TOTAL) | 1.32 (MEAN) |

TABLE 7-28
EFFLUENT LEAD SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 2 SYSTEMS

| Plant ID | Number Of Points | Mean Effluent Concentration (mg/ℓ) |
|---|---|---|
| 38223 | 234 | 0.04 |

TABLE 7-29
EFFLUENT NICKEL SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 2 SYSTEMS

| Plant ID | Number Of Points | Mean Effluent Concentration (mg/ℓ) |
|---|---|---|
| 03043 | 91 | 0.42 |
| 11125 | 29 | 1.75 |
| 15193 | 12 | 0.27 |
| 31021 | 120 | 0.93 |
| OVERALL | 252 (TOTAL) | 0.81 (MEAN) |

TABLE 7-30
EFFLUENT ZINC SELF-MONITORING PERFORMANCE DATA
FOR PLANTS WITH OPTION 2 SYSTEMS

| Plant ID | Number Of Points | Mean Effluent Concentration (mg/ℓ) |
|---|---|---|
| 03043 | 91 | 0.35 |
| 15193 | 12 | 0.14 |
| 31021 | 121 | 0.77 |
| 38223 | 234 | 0.11 |
| OVERALL | 252 (TOTAL) | 0.81 (MEAN) |

Table 7-32 presents the daily maximum, 10-day average, and long term average effluent performance for common metals Option 2. Performance was obtained by multiplying the visited plant mean concentrations of Table 7-23 by the respective variability factors shown in Table 7-31 (except for cadmium and lead, where the weighted mean Option 2 self-monitoring data concentrations were used in place of the visited plant mean effluent concentrations). The allowable daily effluent concentrations for each of the parameters have been shown on Figures 7-10 through 7-16.

TABLE 7-32
OPTION 2 COMMON METAL PERFORMANCE LEVELS

| Pollutant | Daily Max. | 10-Day Average | Long Term Average |
|---|---|---|---|
| Total suspended solids | 46 | 24 | 12.8 |
| Cadmium | 0.42 | 0.16 | 0.08 |
| Chromium, total | 1.55 | 0.95 | 0.32 |
| Copper | 1.52 | 0.93 | 0.37 |
| Lead | 0.14 | 0.09 | 0.04 |
| Nickel | 1.94 | 1.16 | 0.46 |
| Zinc | 1.13 | 0.67 | 0.25 |

Table 7-33 summarizes the percentage of the metal finishing data base below the Option 2 daily maximum concentration limitation for the EPA sampled plants.

TABLE 7-33
PERCENTAGE OF THE MFC DATA BASE BELOW THE DAILY MAXIMUM CONCENTRATIONS FOR OPTION 2

| Pollutant | EPA Sampled Plants Daily Maximum |
|---|---|
| Total suspended solids | 100.0 |
| Cadmium | 100.0 |
| Chromium, total | 100.0 |
| Copper | 100.0 |
| Lead | 100.0 |
| Nickel | 100.0 |
| Zinc | 94.1 |

Summary tables are provided to show a direct comparison of the mean, daily maximum, and 10-day average concentrations for Options 1 and 2. Table 7-34 presents a comparison of the mean concentrations and Table 7-35 lists the daily maximum and maximum monthly average concentrations for each.

TABLE 7-34
OPTION 1 AND OPTION 2 MEAN CONCENTRATION COMPARISON

| | CONCENTRATION (mg/ℓ) | |
|---|---|---|
| Pollutant | Option 1 | Option 2 |
| Total suspended solids | 16.8 | 12.8 |
| Cadmium | 0.19 | 0.08 |
| Chromium, total | 0.572 | 0.319 |
| Copper | 0.815 | 0.367 |
| Lead | 0.20 | 0.04 |
| Nickel | 0.942 | 0.459 |
| Zinc | 0.549 | 0.247 |

TABLE 7-35
OPTION 1 AND OPTION 2 PERFORMANCE COMPARISON

| | CONCENTRATION (mg/ℓ) | | | |
|---|---|---|---|---|
| Pollutant | Option 1 | | Option 2 | |
| | Daily Max. | Maximum Monthly Ave. | Daily Max. | Maximum Monthly Ave. |
| Total Suspended Solids | 60 | 31 | 46 | 24 |
| Cadmium | 0.69 | 0.26 | 0.42 | 0.16 |
| Chromium, total | 2.77 | 1.71 | 1.55 | 0.95 |
| Copper | 3.38 | 2.07 | 1.52 | 0.93 |
| Lead | 0.69 | 0.43 | 0.14 | 0.09 |
| Nickel | 3.98 | 2.38 | 1.94 | 1.16 |
| Zinc | 2.61 | 1.48 | 1.17 | 0.67 |

TABLE 7-44

METAL FINISHING CATEGORY

PERFORMANCE DATA FOR SILVER

VISITED OPTION 1 PLANTS

| Data Point | Raw Waste Concentration (mg/l) | Effluent Concentration (mg/l) | Plant ID |
|---|---|---|---|
| 1. | 0.1780 | 0.1670 | 6087-1-1 |
| 2. | 0.1780 | 0.1190 | 6087-1-3 |
| 3. | 0.2100 | 0.0610 | 21003-15-2 |
| 4. | 0.2700 | 0.0640 | 21003-15-0 |
| 5. | 0.2900 | 0.0690 | 21003-15-1 |
| Mean Concentration = | 0.2252 (n=5) | 0.0960 (n=5) | |

Effluent Silver Self-Monitoring Performance Data
for Plants with Option 1 Systems

| Plant ID | No. of Points | Concentration (mg/l) |
|---|---|---|
| 6087 | 12 | 0.04 |
| 11125 | 5 | 1.66 |
| Overall | 17 | 0.52 |